

CLAIMS

What is claimed is:

- 5 1. A system for making measurements in a wellbore during the construction of the wellbore comprising:
- a first sensor located downhole adapted to measure a first downhole parameter;
- a second sensor located downhole adapted to
10 measure a second downhole parameter;
- a downhole processor in communication with the first and second sensors configured to calculate a statistical relationship between the first and second downhole parameters; and
- 15 a transmitter located downhole and in communication with the downhole processor the transmitter adapted and configured to transmit the calculated statistical relationship to the surface.
- 20 2. A system according to claim 1 wherein the statistical relationship is a covariance.
3. A system according to claim 1 wherein the downhole processor is further configured to calculate the
25 standard deviation and/or mean of each of the first and second downhole parameters.
4. A system according to claim 1 wherein the first
30 downhole parameter is torque, and the second downhole parameter is weight on bit.
5. A system according to claim 1 wherein the first downhole parameter is pressure, and the second downhole parameter is weight on bit.

6. A system according to claim 1 wherein the first downhole parameter is toolface, and the second downhole parameter is weight on bit.

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7. A system according to claim 1 wherein the first downhole parameter is annular pressure, and the second downhole parameter is downhole flowrate of drilling mud.

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8. A system according to claim 2 wherein the statistical relationship is a time-delayed covariance.

9. A system according to claim 1 further comprising:

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a receiver located on the surface positioned and configured to receive the calculated statistical relationship transmitted by the transmitter; and

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a surface processor in communication with the receiver programmed to analyse the calculated statistical relationship.

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10. A system according to claim 9 wherein the surface processor is programmed to compare the calculated statistical relationship with data acquired from other well within a nearby region.

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11. A system according to claim 9 wherein the surface processor is programmed to compare the calculated statistical relationship with measurements acquired on surface equipment of the wellbore.

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12. A system according to claim 9 wherein the processor is configured to display and/or communicate the analyzed statistical relationship such that a surface operating parameter relating to drilling the wellbore can be altered.

13. A system according to claim 12 wherein the calculated statistical relationship is used to make an estimation of bit wear.

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14. A system according to claim 12 wherein the first downhole parameter is torque, the second downhole parameter is weight on bit, and the operating parameter is hookload.

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15. A system according to claim 11 wherein surface processor is programmed to use the compared statistical relationship with the surface data to calculate a frictional correction.

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16. A system according to claim 15 wherein the frictional correction is used to estimate downhole torque and weight on bit.

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17. A system according to claim 15 wherein the frictional correction is used to estimate a relationship between weight on bit and rate of penetration.

18. The system according to claim 11 wherein the surface acquired data comprises rate of penetration.

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19. The system according to claim 12 wherein the first downhole parameter is toolface, and the second downhole parameter is weight on bit, the processor being further programmed to estimate a toolface correction such that improved toolface corrections can be made by altering weight on bit.

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20. A method for making measurements in a wellbore during the construction of the wellbore comprising the steps of:

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measuring downhole a first parameter;
measuring downhole a second parameter;
calculating a statistical relationship between
the first and second downhole parameters; and
5 transmitting the calculated statistical
relationship to the surface.

21. A method according to claim 20 wherein the
statistical relationship is a covariance.

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22. A method according to claim 20 wherein the
first and second parameters are selected from the group
consisting of torque, weight on bit, annular pressure,
pressure inside a drillstring, toolface, and flowrate of
15 drilling mud.

23. A method according to claim 20 wherein the
statistical relationship is a time-delayed covariance.

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24. A method according to claim 20 further
comprising the steps of:

receiving on the surface the calculated
statistical relationship; and

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analysing the calculated statistical
relationship on the surface.

25. A method according to claim 24 wherein the step
of analysing comprises comparing the calculated
statistical relationship with data acquired from other
30 well within a nearby region.

26. A method according to claim 24 wherein the step
of analysing comprises comparing the calculated
statistical relationship with measurements acquired on
35 surface equipment of the wellbore.

27. A method according to claim 24 further comprising the step of altering an operating parameter on the surface relating to drilling the wellbore based at least in part on the analysed statistical relationship.

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